The Effect of Content Knowledge on Pedagogical Content Knowledge: The Case of Teaching Phases of Matters

*Mustafa ÖZDEN**

Abstract

The aim of the present research was to investigate the effect of the amount and quality of content knowledge on pedagogical content knowledge (PCK). The chemical content of phases of matters was used as an example. The research sample consisted of 28 science student teachers. The lesson preparation task, content knowledge test and semi-structured interview were used to collect data. This study shows that science student teachers have basic knowledge, few misconceptions and certain inadequacies at conceptual level. Science student teachers had understanding difficulties about relationship between concepts affected by their previous experiences. It has been seen that most student teachers had consistent content knowledge. The results of this study emphasize that content knowledge had positive influence on pedagogical content knowledge. Content knowledge also influenced effective teaching practice.

Key Words

Content Knowledge, Pedagogical Content Knowledge, Phases of

**Correspondence*: Assist. Prof. Dr. Mustafa ÖZDEN, Adıyaman University, Faculty of Education, Department of Science Education, 02040 Adıyaman, Turkey. E-mail: mozden@adiyaman.edu.tr

Educational Sciences: Theory & Practice
8 (2) • May 2008 • 633-645

Content knowledge is defined as "the concepts, principles, relationships, processes, and applications a student should know within a given academic subject, appropriate for his/her and organization of the knowledge." Pedagogy is the science of teaching, instruction and training. Pedagogical content knowledge (PCK) was first introduced by Shulman (1986, 1987) and defined as teachers' ways of representing and formulating the subject-matter knowledge in the context of facilitating student learning.

Some researchers have argued that there is not always a sharp distinction between PCK and subject matter knowledge because subject matter knowledge functions as a source to be transformed for teaching (Tobin, Tippins, & Gallard, 1994). On the other hand, student-teachers having inaccurate and inadequate knowledge might transfer their own misconceptions to their students (Hashweh, 1987) and in this way add to students' conceptual difficulties (Even, 1993). Kaya (2008) showed that there was a significant interrelationship between the subject matter and pedagogical knowledge of the pre-service science teachers. Similarly, many researchers such as Halim and Meerah (2002), Van Driel, De Jong and Verloop (2002) concluded that content knowledge had influence on pedagogical content knowledge. However, content knowledge had no effect on pedagogical content knowledge according to Mapolelo (1999). The importance of content knowledge on pedagogical content knowledge is somewhat controversial and needs further study.

Teacher's thinking as one of the components of effective teaching in recent years has been the focus of the research studies reported by Lederman and Niess, 2001; Ritchie, 1999; Connelly, Clandinin and He, 1997; Clark and Peterson, 1986; Uşak, 2005; Nakiboğlu et.al. 2005. Putnam (1987) and Borko, Livingstone and Shavelson (1990) stated that efficient teaching consists of packages of contents, goals and teaching methods.

Implemented teacher thinking in classroom interaction is the other type of teacher thinking. Marland & Osborne (1990) and Hogan, Rabinowitz & Craven (2003) concluded that this thinking during teaching concentrates more on students and ways to act rather than on the content. It has been seen that the teachers' thinking was compared in the same category of experience related to researches about student teachers' CK and PCK (Hogan et.al. 2003; Smith & Neale,

1989). Besides this, Hashweh (1987) and Gess-Newsome (1999) argued that experienced teachers have applied their knowledge to teaching easily since they had more constructed knowledge.

Research into CK and PCK related to chemistry topics has been taken place in the literature in recent years. For example, De Jong et.al (2005) stated that most of the chemistry teaching master students had started to think deeper about students' understanding difficulties for particulate nature of matter after applying a special education related to PCK. De Jong et.al (2004) concluded that macro, micro and symbolic meanings related to chemistry topics had developed 8 chemistry student teachers' PCK. In a similar study, De Jong (2000) has found that a special program focused on transferring learning from teaching developed and increased the student teachers' PCK in an experimental course. On the other hand, Mapolelo (1999) concluded that CK had no effect on PCK.

Significance and Aims of the Study

In this research, science student teachers' understanding levels of concepts are examined as a relationship between content knowledge and pedagogical content knowledge. The topic of phases of matters was selected. The student teachers' pedagogical content knowledge was compared by applying the lesson preparation method (Van der Valk, & Broekman, 1999). The study focused on finding out:

- What differences are found in science student teachers' content knowledge?
- Does science student teachers' content knowledge influence their pedagogical content knowledge (of conceptual difficulties of students, knowledge of curriculum, teaching methods and orientation in teaching)?
- What types of pedagogical problems do science student-teachers face when preparing their lesson plans?

Method

The method used for studying the influence of CK on PCK for science student-teachers was the lesson preparation method followed

by interviews (Van der Valk, & Broekman, 1999). The current study was conducted on the basis of three main components of PCK revised by Magnusson, Krajcik and Borko (1999), which was first proposed by Shulman (1986). These main components can be listed as conceptual difficulties of students, teaching goals (knowledge of curriculum) and orientation in teaching. De Jong, Ahtee, Goodwin, Hatzinikita, and Koulaidis (1999) used the same method for science student teachers' PCK related to teaching the concept of burning. In addition, the same method was used by Frederik, Van der Valk, Leite, and Thorén (1999) in teaching the concepts of heat and temperature and also Oldham, Van der Valk, Broekman and Berenson (1999) related to teaching geometrical areas for mathematics student teachers.

Participants

This study was carried out with 28 science student teachers enrolled in the Department of Primary Science Education in Adıyaman University.

Procedures and Instruments

The lesson preparation task, content knowledge test, and semi-structured interviews were used to collect the data.

Lesson Plans

First, science student-teachers were invited to write individual lesson plans for a 2-hour teaching period on the topic of phases of matters for Grade 5 students (aged 11 years). They had 1 hour to write the lesson plans without any books or other material available. They were proctored by the researcher all the time. They were asked to work independently and not to discuss their plans with each other.

The Content Knowledge Test (CKT)

The lesson plan was followed immediately by the content knowledge test. This test was prepared after reviewing the relevant literature (Andersson, 1990; Nakhleh, Samarapungavan and Saglam, 2005; Stavy, 1990; Stavy and Stachel, 1985). It consists of the student-teachers' own understanding of phases of matters and their ideas of students' prior knowledge, alternative conceptions, and le-

arning difficulties within the topic. The test was placed after the lesson plan task so that it did not affect the lesson plan.

Semi-structured Interviews

The interviews took place within 3 weeks after the lesson plan. During the interviews, the student-teachers were encouraged to talk about their lesson plans and their difficulties in writing them. The purpose of the structured interviews (Appendix 1) was to study the student-teachers' content knowledge, Pedagogical Content Knowledge and difficulties in lesson planning, and anticipated problems in teaching and perceived educational needs to perform successfully as a teacher. The duration of the interviews varied from 25 to 50 minutes depending on how much time student-teachers wanted to have.

Results

Science Student Teachers' Content Knowledge

The understanding of phases of matters was analyzed by means of the lesson plans, the content knowledge test, and the semi-structured interviews. According to the available data, there is considerable variance in science student-teachers' understanding of phases of matters in general. This study shows that science student teachers have basic knowledge with few misconceptions and inadequacies about phases of matters. Based on their understanding, three categories were formed (Käpylä et.al, 2008):

Student-teachers' Pedagogical Content Knowledge

Knowledge on Conceptual Difficulties of the Students

The student-teachers' knowledge on the typical conceptual difficulties that students have concerning phases of matters was studied on the basis of their answers in the semi-structured interviews. Science student teachers had understanding difficulties about relationship between concepts affected by previous experiences. It has been seen that most student teachers had consistent content knowledge. The results of this study emphasized that content knowledge had positive influence on pedagogical content knowledge and effective teaching.

Main Teaching Goals (Knowledge on Curriculum)

The main teaching goals (knowledge on curriculum) were studied through student teachers' interviews. Some student teachers emphasized the comparison of the phases of matter and more than half of the participants were focused comparison of phases supported by daily life examples.

Teaching Methods (Educational Activities)

The educational activities preferred by the student teachers were examined using both the lesson plans and the semi-structured interviews. First, the activities collected and then similarities were examined. Finally, educational activities were collected in five different categories. These categories were experimental work, making observation, drama, teaching by games and group working. Most student teachers preferred direct activities such as experimental work, making observation and group working.

Orientation to Teaching

The participants' orientation to teaching was examined through the lesson plans and semi-structured interviews and the student teachers were classified by two categories as proposed by Adams and Krockover (1997). Furthermore, there are many categories in the literature classified by Magnusson and et.al., 1999; Anderson and Smith, 1987; Hashweh's 1996; De Jong and et.al., 1999; Smith and Neale, 1989) but these categories were not used in this study because it was difficult to make an objective evaluation with these categories for this study. Student teachers had mostly preferred constructivist teaching approach (sixteen student teachers) in this study.

Problems in Lesson Planning

The problems in lesson planning and imaginary carrying-out of the lesson were studied using the interview. Four categories were formed: content knowledge; knowledge of the students' understanding of natural science; motivation; and class control. The most common problem that science student-teachers mentioned was their insufficient knowledge of students' scientific understanding. These problems appeared when they tried to figure out how students in the fifth grade think about this topic and what kind of prior knowledge they have. Sample lesson plans at different levels are shown in Appendix 2.

Perceived Educational Needs

The semi-structured interview was used to study the perceived educational needs of the science student teachers. The data were handled as described before and the final classifications were formed: CK; knowledge of teaching methods (activities) of science (PCK); knowledge of students understanding of science (PCK); knowledge of the curriculum of science (PCK) and experience or observation of teaching in the primary school. Majority of the science student-teachers mentioned the knowledge of teaching methods and knowledge about students' understanding of science as the most important educational needs.

Discussion

Science student teachers had the basic knowledge on the topic named phases of matters. They had some misconceptions and inaccuracies on the phases of matters. The results of this study emphasized that content knowledge had positive influence on pedagogical content knowledge and effective teaching as reported by Gess-Newsome, J., & Lederman, N. G. (1995). The most important educational need stated by science student teachers was knowledge about students' understanding of science. This result is consistent with the literature (Adams, & Krockover, 1997; Sanders, L., Borko, H., & Lockard, J. 1993; Schempp, P. G., Manross, D., Tan, S. K. S., & Fincher, M. D. 1998 and Stacey, K., Helme, S., Steinle, V., Baturo, A., Irwin, K., & Bana, J. 2001). This research suggests the view that Pedagogical Content Knowledge should be taught during teacher training supported by the study conducted by Clermont, Borko and Crajcik (1994). Teacher education program should consider the influence of content knowledge on pedagogical content knowledge as a central concept as stated by Jones, A., & Moreland, J. (2004); Zembal-Saul, Starr & Krajcik, 1999; Niess & Scholtz, 1999; Jones & Moreland, 2004; Mason, 1999). CK and PCK research should be simple and practical and help provide guide for conceptual tools for lesson planning. Content representation table combining professional and pedagogical experience proposed by Loughran, Mulhall & Berry (2004) and Loughran et.al. (2001) can be used in in-service training.

References/ Kaynakça

Adams, P. E., & Krockover, G. H. (1997). Beginning science teacher cognition and its origin in the preservice secondary science teacher program. *Journal of Research in Science Teaching*, *34* (6), 633-653.

Anderson, C. W., & Smith, E. L. (1987). Teaching science. In V. Richardson-Koehler (Ed.), *Educators' handbook. A research perspective* (pp. 84-111). New York: Longman.

Andersson, B. (1990). Pupils' conceptions of matter and its transformations (age 12 - 16). *Studies in Science Education*, *18*, 53-85.

Borko, H., Livingston, C., & Shavelson, R. J. (1990). Teachers' thinking about instruction. *Remedial and Special Education*, *11* (6), 40-50.

Clark, C. M., & Peterson, P. L. (1986). Teachers' thought processes. In M. C. Wittrock (Ed.), *Handbook of research on teaching* (3rd ed., pp. 255-296). New York: Macmillan.

Clermont, C. P., Borko, H., & Krajcik, J. S. (1994). Comparative study of the pedagogical content knowledge of experienced and novice chemical demonstrations. *Journal of Research in Science Teaching*, *31* (4), 419-441. Connelly, M. F., Clandinin, D. J., & He, M. F. (1997). Teacher personal practical knowledge on the professional knowledge landscape. *Teaching and Teacher Education*, *13* (7), 665-674.

De Jong, O., Ahtee, M., Goodwin A., Hatzinikita, V., & Koulaidis V. (1999). An international study of prospective teachers' initial teaching conceptions and concerns: The case of teaching 'combustion'. *European Journal of Teacher Education*, *22* (1), 45-59.

De Jong, O. (2000). The teacher trainer as researcher: Exploring the initial pedagogical content concerns of prospective science teachers. *European Journal of Teacher Education*, *23*,127-137.

De Jong, O., & Van Driel, J. (2004). Exploring the development of student teachers' PCK of the multiple meanings of chemistry. *International Journal of Science and Mathematics Education*, *2,* 477-491.

De Jong., O., Van Driel, J., & Verloop, N. (2005). Preservice teachers' pedagogical content knowledge of using particle models when teaching chemistry. *Journal of Research in Science Teaching*, *42,* 947-964.

Even, R. (1993). Subject-matter knowledge and pedagogical content knowledge: Prospective secondary teachers and the function concept. *Journal for Research in Mathematics Education*, *24* (2), 94-116.

Frederik, I., Van der Valk, T., Leite, L., & Thorén, I. (1999). Pre-service physics teachers and conceptual difficulties on temperature and heat. *European Journal of Teacher Education*, *22* (1), 61-74.

Gess-Newsome, J., & Lederman, N. G. (1995). Biology teachers' perceptions of subject matter structure and its relationship to classroom practice. *Journal of Research in Science Teaching*, *32* (3), 301-325.

Gess-Newsome, J. (1999). Secondary teachers knowledge and beliefs about subject matter and their impact on instruction. In J. Gess-Newsome & N. G. Lederman (Eds.), *Examining pedagogical content knowledge* (pp. 51-94). Dordrecht, The Netherlands: Kluwer Academic Publisher.

Halim, L., & Meerah, S. M. (2002). Science trainee teachers' pedagogical content knowledge and its influence on physics teaching. *Research in Science & Technological Education*, *20* (2), 215-225.

Hashweh, M. Z. (1987). Effects of subject matter knowledge in the teaching of biology and physics. *Teaching & Teacher Education*, *3* (2), 109-120.

Hashweh, M. Z. (1996). Effects of science teachers' epistemological beliefs in teaching. *Journal of Research in Science Teaching*, *33* (1), 47-263.

Hogan, T., Rabinowitz, M., & Craven, J. A. (2003). Representation in teaching. Inferences from research of expert and novice teachers. *Educational Psychologist*, *38* (4), 235-247.

Jones, A., & Moreland, J. (2004). Enhancing practicing primary school teachers' pedagogical content knowledge in technology. *International Journal of Technology and Design Education*, *14*, 121-140.

Käpyläa M., Heikkinenb, J., & Asuntaa T. (2008). Influence of content knowledge on pedagogical content knowledge: The case of teaching photosynthesis and plant growth. *International Journal of Science Education*, *2008*, 1-21.

Kaya, O.N (2008). The nature of relationships among the components of pedagogical content knowledge of preservice science teachers: 'Ozone layer depletion' as an example. *International Journal of Science Education,* 1-28.

Lederman, N. G., & Niess, M. L. (2001). An attempt to anchor our moving targets. *School Science and Mathematics*, *101* (2), 50-57.

Loughran, J., Milroy, P., Berry, A. Gunstone, R., & Mulhall, P. (2001). Documenting science teachers' pedagogical content knowledge through PaP-eRs. *Research in Science Education*, *31*, 289-307.

Loughran, J., Mulhall, P., & Berry, A. (2004). In search of pedagogical content knowledge in science: Developing ways in articulating and documenting professional practice. *Journal of Research in Science Teaching*, *41* (4), 370-391.

Magnusson, S., Krajcik, J., & Borko, H. (1999). Nature, sources and development of pedagogical content knowledge for science teaching. In J. Gess-Newsome & N. G. Lederman (Eds.), *Examining pedagogical content knowledge* (pp. 95-132). Dordrecht, The Netherlands: Kluwer Academic Publisher.

Mapolelo, D. C. (1999). Do pre-service primary teachers who excel in mathematics become good mathematics teachers? *Teaching and Teacher Education*, *15*, 715-725.

Marland, P., & Osborne, B. (1990). Classroom theory, thinking and action. *Teaching and Teacher Education*, *6* (1), 93-109.

Mason, C. L. (1999). The TRIAD approach: A concensus for science teaching and learning. In J. Gess-Newsome & N. G. Lederman (Eds.), *Examining pedagogical content knowledge* (pp. 277-292). Dordrecht, The Netherlands: Kluwer Academic Publisher.

Nakhleh, M. B., Samarapungavan, A., & Saglam, Y. (2005). Middle school students' beliefs about matter. *Journal of Research in Science Teaching*, *42* (5), 581.

Nakiboğlu, C., & Karakoç, Ö. (2005). The forth knowledge domain a teacher should have: The pedagogical content knowledge. *Educational Sciences: Theory and Practice, 5* (1), 201-206.

Niess, M. L., & Scholz, J. (1999). Incorporating subject matter specific teaching strategies into secondary science teacher preparation. In J. Gess-Newsome, &

N. G. Lederman (Eds.), *Examining pedagogical content knowledge* (pp. 257-276). Dordrecht, The Netherlands: Kluwer Academic Publisher.

Oldham, E., Van der Valk, T., Broekman, H., & Berenson, S. (1999). Beginning preservice teachers' approaches to teaching the area concept: Identifying tendencies towards realistic, structuralist, mechanist or empiricist mathematics education. *European Journal of Teacher Education*, *22* (1), 23-43.

Putnam, R. T. (1987). Structuring and adjusting content for students. A study of live and simulated tutoring of addition. *American Educational Research Journal*, *24* (1), 13-48.

Ritchie, S. M. (1999). The craft of intervention: A personal practical theory for the teacher's within group interactions. *Science Education*, *83* (2), 213-231.

Schempp, P. G., Manross, D., Tan, S. K. S., & Fincher, M. D. (1998). Subject expertise and teachers' knowledge. *Journal of Teaching in Physical Education*, *17* (3), 342-356.

Sanders, L., Borko, H., & Lockard, J. (1993). Secondary science teachers' knowledge base when teaching science courses in and out of their area of certification. *Journal of Research in Science Teaching*, *30* (7), 723-736.

Shulman, L. S. (1986). Those who understand knowledge growth in teaching. *Educational Researcher*, *15*, 4-14.

Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review*, *57*, 1-22.

Smith, D. C., & Neale, D. C. (1989). The construction of subject matter knowledge in primary science teaching. *Teaching and Teacher Education*, *5* (1), 1-20.

Stacey, K., Helme, S., Steinle, V., Baturo, A., Irwin, K., & Bana, J. (2001). Preservice teachers' knowledge of difficulties in decimal numeration. *Journal of Mathematics Teacher Education*, *4* (3), 205-225.

Stavy, R. (1990). Childrens conception of changes in the state of matter - from liquid (or solid) to gas. *Journal of Research in Science Teaching*, *27* (3), 247-266.

Stavy, R., & Stachel, D. (1985). Children's conception of changes in the state of matter: From solid to liquid. *Archives de Psychologie*, *53*, 331-344.

Tobin, K., Tippins, D., & Gallard, A. (1994). Research on instructional strategies for teaching science. In D. L. Gabel (Ed.), *Handbook of research on science teaching and learning* (pp. 45-93). New York: Macmillan.

Uşak, M. (2005). *Prospective elementary science teachers' pedagogical content knowledge about flowering plants.* Unpublished doctoral thesis, Gazi University, Ankara.

Van der Valk, T., & Broekman, H. (1999). The lesson preparation method: A way of investigating pre-service teachers' pedagogical content knowledge. *European Journal of Teacher Education*, *22* (1), 11-22.

Van Driel, J. H., Verloop, N., & De Vos, W. (1998). Developing science teachers' pedagogical content knowledge. *Journal of Research in Science Teaching*, *35* (6), 673-695.

Van Driel, J., De Jong, O., & Verloop, N. (2002). The development of pre-service chemistry teachers' pedagogical content knowledge. *Science Education*, *86*, 572-590.

Zembal-Saul, C. Starr, M. L., & Krajcik, J. S. (1999). Constructing a framework for elementary science teaching. In J. Gess-Newsome & N. G. Lederman (Eds.), *Examining pedagogical content knowledge* (pp. 237-256). Dordrecht, The Netherlands: Kluwer Academic Publisher.

Ek-1

MADDENİN FİZİKSEL HÂLLERİ PEDAGOJİK ALAN BİLGİSİ TESTİ

Adı ve Soyadı: *Sınıfı ve Bölümü:*

1) Biz öğretmen olarak maddenin hâllerini neden öğrenir ve neden öğrencilere öğretiriz?

2) Maddenin fiziksel hâlleriyle ilgili olarak öğrencilere öğretmek istediğiniz en önemli konu nedir?

a) Bu konunun neden çok önemli olduğunu düşünüyorsunuz?

b) Dersinizde öğretilecek başka önemli konular var mıdır? Varsa onların neden önemli olduğunu düşünüyorsunuz?

3) Maddenin hâlleri konusunu anlatırken ders esnasında ne tür sorunlarla karşılaşacağınızı düşünüyorsunuz? Neden?

4) Maddenin fiziksel hâlleriyle ilgili dersinizi anlattıktan sonra öğrencilerin hangi yeni kavramları anlayacağını düşünüyorsunuz?

a) Öğrencilerinizin neden sadece o konuları öğreneceğini düşünüyorsunuz?

b) Öğrencilerinizin öğreneceğini düşündüğünüz başka konular var mıdır? Neden öğrencilerin sadece bu konuları öğreneceğini düşünüyorsunuz?

5) Genel olarak maddenin fiziksel hâlleri konusunu anlatmayı düşündüğünüzde ne tür olumlu ve olumsuz düşünce ve duygular akla gelmektedir? Neden?

6) Maddenin fiziksel hâlleri konusunu anlatırken en çok hangi bölümde daha çok destek ve yardıma ihtiyaç duyacağınızı düşünüyorsunuz? Neden?

Ek-2. Farklı düzeylerde hazırlanmış ders planı örnekleri

Adı ve Soyadı: Özcan Kundak **Sınıfı ve Bölümü:** Fen Bilgisi Öğrt. 1. sınıf

Aşağıda verilen hedef ve sizin tasarladığınız davranışları kazandırmayı amaçlayan bir fen bilgisi öğretmeni olduğunuzu varsayarak **Maddenin Fiziksel Halleri** konusunu ilköğretim 5. sınıf düzeyindeki öğrencilere anlatmak için bir ders planı hazırlayınız.

Not: Ders planı hazırlarken aşağıdaki aşağıdaki başlıkları kullanabilirsiniz.

1) Önerilen süre (ders saati)
2) Konunun Amacı
3) Muhtemel konu başlıkları
6) Etkinlik Örnekleri
7) Değerlendirme Soruları

Hedef: Maddenin hallerini kavrayabilme

Önerilen Süre: Anlatılacak olan konuların zorluk dereceleri ve çocuğun anlaya-
bilmesi için geçen süre aynı değildir. Bir konu için 2 hafta ayrılırken
diğer bir konu için 3 gün yeterli olabilir. Bu nedenle konuya ayrılacak süre
konuya göre değişir. Bu hafta anlatılacak olan konu fen bilgisinin temelini
oluşturduğu için üzerinde durulması gerekir. Konu iyice öğretilmeli anlaşılmadan
geçilmemeli.

Konunun Amacı: Günlük yaşantımızda bir çok maddeyle iç içeyiz. Bunların
hangisinin ne yapıda olduğu bilmek işimizi kolaylaştırır. Maddenin doğa kaç
halde olduğunu, bunların nerede karşımıza çıktığı, yaşamımızı sürdürürken
kullandığımız bu maddelerin doğasını kısacası evreni oluşturan bu maddenin
kendi iç yapısını anlatmak konunun amacıdır.

Konu Başlıkları: Konunun daha iyi anlaşılması için ayrıntıya inmek konuyu
başlıklara ayırmak gerekir. Örneğin; Maddenin halleri genel olarak 3 gruba
ayırırız (katı, sıvı, gaz) Bu bölümlerden mesela katı halini bir günde; tanımını
yaparak, örnekler vererek, ve yaşa uygulamalı olarak kavranmasını sağlarım.

Etkinlik: Konunun akılda daha kalıcı olması öğrenciye somut birşeyler
göstermek lazımdır. Örneğin sınıfta; sürekli iç içe olduğumuz sıraların madde-
nin katı halde olduğu, hayatımızı devam ettirmek için içtiğimiz suyun sıvı
halde olduğu, dünyamızı saran, nefes alıp vermemizi sağlayan havanın maddenin
gaz halde olduğunu söylerim. Konunun anlaşıldığına inandığım zaman ödev
olarak onlarında maddenin hallerine örnek vermelerini, yaratıcı olarak akıllarına
gelenleri söylemelerini söylerim.

Değerlendirme soruları: Konu anlatıldıktan sonra hem konunun anlaşıldığını
ölçmek hemde anlaşılanları pekiştirmek için soru-cevap şeklinde dersi
bitiririm.

1- Elimizi havada salladığımız zaman hiçbir şeye çarpmadığını görürüz. Fakat bu
maddenin bir halini oluşturmakta bu maddenin hangi halidir?

Adı ve Soyadı: İrem Akdoğanlar **Sınıfı ve Bölümü:** 1 Fen Bilgisi

Aşağıda verilen hedef ve sizin tasarladığınız davranışları kazandırmayı amaçlayan bir fen bilgisi öğretmeni olduğunuzu varsayarak **Maddenin Fiziksel Halleri** konusunu ilköğretim 5. sınıf düzeyindeki öğrencilere anlatmak için bir ders planı hazırlayınız.

Not: Ders planı hazırlarken aşağıdaki aşağıdaki başlıkları kullanabilirsiniz.

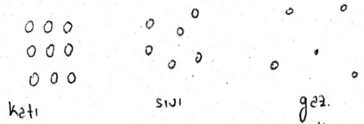
1) Önerilen süre (ders saati) **Hedef:** Maddenin hallerini kavrayabilme
2) Konunun Amacı
3) Muhtemel konu başlıkları
6) Etkinlik Örnekleri
7) Değerlendirme Soruları

Ders saati: 40 dk.

Konunun amacı: Maddenin fiziksel hallerini öğrenciye en iyi biçimde kavratabilmek. Gündelik hayattan örnekler vererek öğrenciyi sıkmadan dersi kavramasını sağlamak.

Maddenin Fiziksel Halleri: Öncelikle madde nedir?

Madde: Belirli bir hacmi, kütlesi olan boşlukta yer kaplayan nesnelere madde denilir. Doğada madde üç halde bulunur. Bunlar katı, sıvı, gaz dır.



Şekilde de gördüğünüz gibi arkadaşlar maddenin en düzenli hali katı en düzensiz halide gazdır. Burdan da sonuç çıkarabiliriz o halde katı'dan gaza doğru düzensizlik artar.

Katı maddenin en düzenli hali olmasının yanı sıra belirli bir şekli vardır. Sıvı hali katı halinden biraz daha düzensizdir ve kabın şeklini alır. Gaz hali ise en düzensiz halidir ve bulunduğu kabın şeklini alır.

Katı maddenin belirli bir şekli ve hacmi var.
Sıvı " " " " yok fakat hacmi var.
Gaz " " " " ve hacmi yok. Bulunduğu kabın hacmini kaplar.

Hal Değişimleri: Maddeler hal olarak birbirine dönüşebilirler. Biz buna da hal değişimi adını veriyoruz.

$$\text{Katı} \underset{\text{Donma}}{\overset{\text{Erime}}{\rightleftarrows}} \text{Sıvı} \underset{\text{yoğunlaşma}}{\overset{\text{buharlaşma}}{\rightleftarrows}} \text{Gaz}$$

$$\xrightarrow{\text{süblimleşme}}$$

Yukarıdaki şemadan da anlaşılacağı gibi maddenin katı halden sıvı hale geçmesine erime denir. Buzluktan çıkardığımız buzun güneşin altında birkaç dakika bekledikten sonra suya dönüştüğünü hepimiz günlük hayatımızda görmüşüzdür.